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ABSTRACT

A study was conducted to determine the relationship between visual perception-visual motor deficits and reading achievement of remedial readers, and to analyze the performance of various subjects in the three classifications of perceptual dysfunction to determine if significant differences existed among them. Subjects were 102 remedial readers between the ages of 7 and 22. Subjects were given a battery of diagnostic tests, including the Minnesota Percepto-Diagnostic Test (MPDT). Based on the scores of this test, the subjects were classified into one of three categories: (1) primary group, whose problems are associative rather than perceptual: (2) secondary group, who have difficulty handling cues selectively: and (3) organic group, composed of those with severe dysfunction caused by neurological deficit or brain damage. The results showed a significant negative correlation between reading achievement and perceptual-motor dysfunction. There were no significant intergroup differences in types of errors for the primary and secondary groups, and the three groups showed no significant differences in chronological or mental ages, school grade, reading achievement scores, or instructional reading levels. (FL)

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Visual Perception-Visual Motor Deficits and Reading Achievement

by

Lillian R. Putnam

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Introduction

Tests of visual perception and visual-motor functioning are frequently administered in reading clinics to determine the presence of deficits. Subsequent remediation is often based on these results, using a process oriented model of reading. The purposes of this study were 1.) to determine the relationship between visual perception - visual motor deficits and reading achievement of remedial readers, and 2.) to analyze the categories of difficulty to determine if significant differences existed between them.

The following two hypotheses were made. First, that there would be a significant, negative correlation between reading achievement and perceptual-motor dysfunction. Second, that there would be no significant differences within or between the various classifications of perceptual dysfunction in types of errors.

Related Literature

Spache's (1976) review of twenty-three studies of visual-motor training programs indicated that only fifteen were successful. His summary of thirty-two perceptual training programs showed that almost all had gain in visual perception

per se, but less than one half made gain in reading achievement.

After their review of specific training programs, Hammill, Goodman and Wiederholt (1974) concluded the majority showed that visual-motor processes cannot be trained.

Of the eleven studies on perceptual-motor development and reading, selected because of their good research designs, Klesius (1972) found that only five had positive effects on reading achievement, five had no effect, and one was inconclusive.

For years, many reading teachers assumed that remediation should stress the preferred modality. This concept was challenged by Robinson's (1972) study, which demonstrated that phonic training in the preferred modality made no significant difference.

Ringler, Smith and Cullinan (1971) tested 128 first grade children with the New York University Modality Test to identify learning preferences. They found no apparent relationships between modality preferences, mode of presentation and learning.

Although only sample studies are cited here, it seems that one reason for the confusion and lack of positive training programs in the areas of modalities is that no one test adequately covers the field. A second reason is that identification of modal strengths and weaknesses characterizes only a small portion of the total skills involved in the reading process. The pitfall of modality studies seems to be in attempting to make a direct remedial prescription based on modality deficits, whereas it is predominantly the intergrative and synergistic abilities which vitally affect reading. There is also little or no theoretical support for basing remedial programs on test results which fractionate preception, as has been suggested by Mann and Phillips (1967). It is probable as Kamil (1978) has noted, that level of ability has much to do with the issue of modality.

In a study of 199 pairs of normal and severely disabled readers, Valtin (1978) found no connection with disturbances of visual perception, or of spatial abilities in retarded readers. However she questioned this finding because the matched-pair method used in the research design resulted in a sampling of poor readers with higher I.Q.^{s} than the mean of their population, and normal readers with lower I.Q.^{s} than the mean of their population.

Beery's (1967) Developmental Test of Visual-Motor Integration presents the child with a visual stimulus of 24 geometric designs to copy. Although the stimuli are more varied than those of the Minnesota Percepto-Diagnostic Test (MPDT) (Fuller, 1969), the general task is similar. Beery reported correlations with intelligence in Grades 1, 4 and 7 as .59, .37, and .38 respectively.

Using the MPDT, Kreitman's (1969) study successfully identified correctly 82% of emotionally disturbed cases from those of organic dysfunction. Krippner (1966) reported that the MPDT had been administered to twenty-four cases previously classified by clinical diagnosis, and correctly identified twenty-two out of twenty-four cases. Thus when given for the intended purpose, the MPDT appears to be useful and merits further study.

Fuller and Friedrich (1975) classified 172 remedial children into the three classifications, and noted the following. The Primary Group showed auditory deficits, weakness in association levels relating to concepts presented auditorily and visually, and weakness in verbal expression rather than in manual expression. They had difficulty with symbols, and in associating and expressing them meaningfully through the verbal channels.

The Secondary Group has association, spatial orientation and attention span problems and exhibited anxiety, tension and frustration. Misinterpretation and distortion resulted from anxiety. Children in both the Primary and Secondary classifications were usually able to see and correct their errors when cues were given.

The Organic Group presented auditory and visual problems in reception, association and expression. There were more motor impairments, distortions and separations of figures. Laterality and time concepts were poor. Children in this group were usually unable to correct their reproductions on a second trial. Fuller and Friedrich implied that the automatic abilities of children were more closely related to reading disability than were those at the symbolic or representational level, although later research did not totally support these findings.

Some experienced clinicians have concluded that visual-motor training may improve performance on those tasks per se, with little or no transference to reading achievement (Hammill and Bardel, 1978). Others have found that analysis of visual-motor performance is still helpful in the diagnosis and classification of disabled readers (Fuller and Friedrich, 1975).

Tarnpol and Tarnpol (1977) suggested a simple, practical procedure to determine whether the impairment is in visual-perceptive imput, perceptual-motor output, or in associative functions involving the translation of visual imput into motor output. They present the child with two or three of his worst drawings and have him compare them with the models. If he sees and identifies differences, then the problem is usually not one of visual perception. If he can describe how his should be corrected, the problem is not associative. Knowing this, if he still cannot improve his drawings on repeated attempts, the problem is probably motor.

Singer (1978) reminds us that as early as 1926, Arthur Gates' work showed "that perception is not a unitary function; correlations among perception of numbers, geometric symbols and printed words were quite low, averaging only .35; training in laterality, tracing lines, matching block designs, or motor activities is not likely to transfer to perception or printed words; what is most effective is training on discrimination and perception of printed words."

Population Sample

One hundred and two students in the Remedial Section of the Reading Clinic of Kean College of New Jersey were included in the study. Students had been admitted to Remediation based upon information from a complete battery of diagnostic tests previously administered in the Diagnostic Section. These tests included the following: Woodcock Reading Mastery Test, Wide Range Achievement Test, Slosson Intelligence Test, Developmental Test of Visual-Motor Integration, Peabody Picture Vocabulary Test, Detroit Tests of Learning Aptitude, California Test of Personality, Durrell Listening-Hearing Test, Wepman Test of Auditory Discrimination, audiometer and telebinocular screening tests. All students were judged remedial, based on discrepancies between achievement and expectancy, using Wilson's (1977) standard of tolerance.

Students came from urban, suburban and rural areas. The population sample included the following: age range 7-2 to 14-11, with the Adult Group ranging from 15-3 to 22-8; mental ages from 6-4 to 16-5; grade levels from 2.8 - 12.8; reading achievement grade levels from 1.6 - 12.3. There were 82 males and 20 females, a four to one ratio.

The Study

Data were collected between Fall 1977 and Spring 1979. The Minnesota Percepto-Diagnostic Test (MPDT) by Fuller (1969) was selected to test visual perception - motor functioning, and was administered individually and scored by the writer. The Woodcock Reading Mastery Test (WRMT) by Woodcock (1973) was administered to measure reading achievement, by graduate students in the Remediation Section of the Master's Reading Program, under the writer's supervision.

Intercorrelations were computed for chronological age, mental age, MPDT and WRMT raw scores. The means of the different variables were compared within each classification to determine statistical differences. The group error scores

in each of the MPDT classifications were analyzed to determine if significant differences existed within and between groups, by analysis of variance. Within and between group analysis of separations and distortions was also done.

Description of the Tests

The MPDT is suitable for ages eight to fourteen, with separate scoring for adults. The subject is presented with six stimulus cards, similar to Wertheimer's designs, and asked to copy them. Reproductions are scored for rotation, separation and distortion. The test has a standard procedure, objective scoring, and is simple, brief and untimed. Scores of remedial readers are assigned into one of three categories:

1. Primary Group - signifying minimal rotations; problems are associative rather than perceptual.
2. Secondary Group - increased rotations; difficulty handling cues selectively; emotional overlay prevents use of known skills.
3. Organic Group - excessive rotations; severe dysfunction caused by neurological deficit or brain damage.

Standardized on 5,552 children ranging from age five to twenty-one, the test was able to identify correctly 84% of Normal, 80% Emotionally Disturbed, and 79% of Brain Damaged children. Thus the criterion group validity is good. Fuller also reported test-retest reliabiltiy correlations of .85 for classifications of Normal Children, .82 for Emotionally Disturbed, and .74 for Brain Damaged Children. Raw scores indicating errors were used.

The WRMT is a battery of five, individually administered reading tests: Letter Identification, Word Identification, Word Attack, Word Comprehension and Passage Comprehension. Two forms are available and it is suitable for grades one through twelve. Raw Scores were used. Mastery

grade levels are given at which the subject will demonstrate 90%, 96% and 75% mastery of the task. A joint norm-referenced and criterion referenced scale is available. The test was normed on 5,000 children. Woodcock reported validity correlations of .84, .94, .90, and .88 for the five subtests respectively. Split-half reliability correlations of .76, .97, .94, .90 are given for the five subtests and .99 for the total battery.

Findings

The MPDT assigned total error scores into one of three classifications: fifty-one in Primary, twenty-four in Secondary, and thirteen in Organic. Fourteen children over age fourteen comprised the Adult group. Table 1 presents the Pearson Product-Moment inter-correlations of chronological age, mental age - MPDT and WRMT raw scores. The negative correlation of -0.364 between the MPDT raw error scores and WRMT raw scores was highly significant (P = .01). Thus the first hypothesis of a significant negative correlation between perceptual motor dysfunction and reading achievement was accepted.

There were also significant negative correlations (P = .01) between chronological age and perceptual dysfunction, and between mental age and perceptual dysfunction. As anticipated there were postive correlations (P = .01) between chronological age and mental age, and between WRMT scores, chronological and mental ages.

Table 1

Intercorrelations of Chronological Age, Mental Age, Minnesota Percepto-Diagnostic Test Error Scores and Woodcock Reading Mastery Tests

	C.A.	M.A.	MPDT	WRMT
C.A.	1.00	0.754**	-0.400**	0.608**
M.A.		1.00	-0.369**	0.728**
MPDT			1.00	-0.364**
WRMT				1.00

N = 102
** significant at .01 level

Because the presence of the Adult group seemed to be affecting the data, a second correlation matrix was computed excluding the Adult group, and is presented in Table 2.

Table 2

Intercorrelations of Chronological Age, Mental Age, Minnesota Percepto-Diagnostic Test Error Scores and Woodcock Reading Mastery Tests (Adult Group Excluded)

	C.A.	M.A.	MPDT	WRMT
C.A.	1.00	0.707**	-0.326**	.628**
M.A.		1.00	-0.282**	0.713**
MPDT			1.00	-0.267*
WRMT				1.00

* = significant at .05 level
** = significant at .01 level
N = 102

Again the negative correlation of -0.267, although lower, was significant (P = .05) between MPDT raw error scores and WRMT raw scores. This reconfirmed the finding of a significant negative correlation between the two variables. Excluding the adult group, correlations were again significant (P = .01) between chronological age and mental age; between chronological age and MPDT scores; and between chronological age and WRMT scores as was expected.

The means and standard deviations of the mental ages expressed in months of the Primary, Secondary, Organic and Adult group are given in Table 3.

Table 3

Means and Standard Deviations of Mental Ages of Primary, Secondary, Organic and Adult Groups (Expressed in Months)

	Mental Ages
Primary	
Mean	126.510
S.D.	25.105
N	51
Secondary	133.667
Mean	27.150
S.D.	24
N	
Organic	
Mean	142.615
S.D.	28.573
N	13
Adult	
Mean	175.714
S.D.	14.301
N	14

Total N = 102

Comparison of the means in the separate MPDT categories was done by analyses of variance and Duncan's Multiple Range Test for Variable Scores, on the following variables: chronological and mental ages, grade levels, MPDT error raw scores, WRMT scores, and instructional reading levels. These findings are presented in Table 4. (Instructional reading levels were clinically assigned.)

Table 4

Analyses of Variance for Chronological Age, Mental Age, Grade Level, Minnesota Percepto-Diagnostic Test, Woodcock Reading Mastery Tests and Instructional Reading Level for Primary, Secondary, Organic and Adult Groups.

Variable	Source of Variation	df	Sum of Squares	Mean Square	F
C.A.	Groups	3	52246.71	17415.57	31.00**
	Error	98	55064.27	561.88	
M.A.	Groups	3	27271.987	9090.662	14.62**
	Error	98	60922.012	621.653	
Grade Level	Groups	3	327.13	109.04	31.12**
	Error	98	343.35	3.503	
M.P.D.T.	Groups	3	18451.48	6150.49	35.11*
	Error	98	17167.53	175.17	
W.R.M.T.	Groups	3	1856.07	618.69	3.96*
	Error	98	15312.60	156.25	
Instructional Reading Level	Groups	3	72.13	24.04	4.84*
	Error	98	486.63	4.96	

* significant at .05 level
** significant at .01 level
N = 102

There were significant differences between the Adult group and the other three groups (P = .01) in chronological age, mental age, and Grade Levels. There were no significant differences however, between the Primary, Secondary, and Organic groups on these three variables. (P = Primary, S = Secondary, O = Organic)

MPDT raw error scores were significantly different (P = .05) between the P, S and O groups as was expected. There was no significant difference between the Adult and Primary groups.

The Adult group was significantly different (P = .05) from the other three groups on the WRMT raw scores and on the Instructional Reading Level. There were no significant differences between the other three groups on either of the two variables.

The significant finding here is that there were no significant differences between the Primary, Secondary and Organic groups in chronological and mental ages, school grade levels, WRMT scores and instructional reading levels.

Of the fourteen students in the Adult group, 6 or 42 percent were in the Normal perception group, 7 or 50 percent in the Personality Disturbance group, and 1 or 7 percent in the Organic group. As expected, the Adult group was significantly different from the younger group in age, school grade, mental age, and WRMT raw scores, but not from the Primary group in MPDT raw scores.

As consistent with Fuller's (1969) findings, children in the Primary and Secondary classifications were able to recognize and usually to correct their errors; children in the Organic group were not.

Error Analysis

Analysis of MPDT error scores is shown in Table 5. Mean and standard deviations are given for each of the six cards in the P, S, O and Adult groups.

Table 5

Analysis of Error Scores of the
Minnesota Percepto-Diagnostic Test

Category	Card I	II	III	IV	V	VI
Primary						
Mean	3.627	4.196	5.235	4.353	4.882	5.784
S.D.	3.38	3.617	5.07	4.349	4.371	5.434
N = 51						
Secondary						
Mean	4.333	8.75	6.167	7.28	6.50	8.542
S.D.	2.253	6.89	5.55	6.20	6.72	7.84
N = 24						
Organic						
Mean	4.077	15.154	8.692	13.769	5.154	20.308
S.D.	3.095	9.831	6.981	9.558	5.414	10.185
N = 13						
Adult						
Mean	2.286	3.857	4.286	3.071	5.00	5.143
S.D.	1.858	4.639	5.159	5.030	3.508	5.96
N = 14						

Detailed intra-group analyses of variance were made of the MPDT performance on the six card stimuli. Intra-group analyses presented in Table 6, showed no significant differences between error scores of Cards I - VI for the Primary, Secondary and the Adult groups. The Organic group had significant differences (P = .01) between Cards I and VI, and between V and VI. The others were homogeneous. Thus the Organic group had significantly greater perceptual dysfunction with the horizontal arrow figure than with the lateral or vertical circle-diamond cards.

Table 6

Intra-group analyses of Variance of Six Card Error Scores on Minnesota Percepto-Diagnostic Test with Primary, Secondary, Organic and Adult Groups

Variable	Source of Variation	df	Sum of Squares	Mean Square	F
Primary Group N = 51	Groups	5	153.908	30.782	1.57
	Error	300	5888.706	19.629	
Secondary Group N = 24	Groups	5	323.917	64.783	1.73
	Error	138	5165.083	37.428	
Organic Group N = 13	Groups	5	2583.961	516.792	8.17**
	Error	72	4552.154	63.224	
Adult Group N = 14	Groups	5	86.631	17.326	0.90
	Error	78	1500.071	19.232	

** significant at .01 level

Inter-group analyses of variance, presented in Table 7, showed no significant differences between the groups on Cards I, III and V. Card II had significant difference (P = .01) between P, S and O groups, but no significant difference between P and Adult groups. Card IV had significant differences (P = .01) between P, S and O groups, but no significant difference between P and Adult

groups. On Card VI, O group was significantly different from all other groups (P = .01). Thus the Primary, Secondary and Organic groups had significantly different perceptual dysfunction on the arrow figure.

Table 7

Inter-group Analyses of Variance of Six Card Error Scores of Minnesota Percepto-Diagnostic Test with Primary, Secondary, Organic and Adult Groups

Variable	Source of Variation	df	Sum of Squares	Mean Square	F
Card I	Groups	3	39.631	13.211	1.51
	Error	98	859.035	8.766	
Card II	Groups	3	1462.142	487.381	14.99**
	Error	98	3185.946	32.510	
Card III	Groups	3	160.217	53.406	1.93
	Error	98	2706.136	27.614	
Card IV	Groups	3	1077.913	359.304	10.81**
	Error	98	3256.842	33.233	
Card V	Groups	3	44.974	14.991	0.59
	Error	98	2506.986	25.581	
Card VI	Groups	3	2337.09	779.003	16.63**
	Error	98	4591.069	46.848	

** .01 level

Therefore the hypothesis that there would be no significant differences within the groups in types of errors was rejected for the Organic group, and accepted for the Primary, Secondary and Adult groups. The hypothesis of no significant differences between the groups was rejected since P, S and O groups had significant difference on Cards II and IV, and the Organic group was significantly different on Card VI.

Brain-damage Indicators

The MPDT provides indicators of brain damage by counting the separations and distortions of circle-diamond and the distortions of dots. Table 8 gives

the means and standard deviations of these indicators by groups.

Table 8

Comparison of Separations and Distortions of Circle-Diamonds, and Distortion of Dots

	SpCD	DCD	DD
Primary Group			
Mean	0.0588	0.1961	0.0784
S.D.	0.2376	0.4907	0.3372
N = 51			
Secondary Group			
Mean	0.0833	0.2500	0.1667
S.D.	0.2823	0.6079	0.4815
N = 24			
Organic Group			
Mean	0.00	0.3077	0.6923
S.D.	0.00	0.4804	1.1821
N = 13			
Adult Group			
Mean	0.00	0.0714	0.00
S.D.	0.00	0.2673	0.00
N = 14			

N = 102

Intra-group and inter-group analyses of separation and distortion errors are presented in Tables 9 and 10. Analyses of variance with the Duncan Test showed no significant difference within any of the groups (Table 9). Inter-group analysis showed no significant differences on separation of circle-diamond and distortion of circle diamond. In distortion of dots, the Organic group was significantly different (P = .01) from each of the other three groups. There were no significant differences between the Primary, Secondary and Organic groups (Table 10).

Table 9

Intra-group Analyses of Variance of Separation and Distortion of Circle-Diamond, and Distortion of Dots for Primary, Secondary, Organic and Adult Groups

Variable	Source of Variation	df	Sum of Square	Mean Square	F
Primary Group N = 51	Group	2	0.562	0.281	2.05
	Error	150	20.549	0.137	
Secondary Group N = 24	Group	2	0.323	0.167	0.73
	Error	69	15.667	0.227	
Organic Group N = 13	Group	2	3.128	1.564	2.88
	Error	36	19.538	0.543	
Adult Group N = 14	Group	2	0.048	0.0239	1.00
	Error	39	0.9292	0.0239	

N = 102

Table 10

Inter-group Analyses of Variance of Separation and Distortion of Circle-Diamond, and Distortion of Dots for Primary, Secondary, Organic and Adult Groups

Variable	Source of Variation	df	Sum of Square	Mean Square	F
SCD	Group	3	0.098	0.033	0.69
	Error	98	4.657	0.047	
DCD	Group	3	0.439	0.146	.59
	Error	98	24.237	0.247	
DD	Group	3	4.378	1.459	5.15**
	Error	98	27.789	0.284	

** significant at .01 level
N = 102

Table 11 shows numbers of students with one or more brain-damage indicators within MPDT classifications.

Table 11

Incidence of Brain-Damage Indicators

Group	Number	Percent
Primary N = 51	8/51	15.6
Secondary N = 24	5/24	20.8
Organic N = 13	4/13	30.7
Adult N = 14	0/14	0

As was anticipated, the percentage of students with brain-damage indicators increased within P, S and O groups respectively. The percentage of the Organic group exceeded the others and doubled that of the Primary group.

Percentage of students making Separation and Distortions is reported in Table 12.

Table 12

Percentages of Separations and Distortions of Circle-Diamond and Dots

	SpCD		DCD		DD	
Group	No.	Percent	No.	Percent	No.	Percent
Primary	3/51	5.8	10/51	19.6	4/51	7.8
Secondary	2/24	8.3	4/24	16.6	3/24	12.5
Organic	0/13		4/13	30.7	4/13	30.7
Adult	0/14		1/14	7.1	0/14	

Although not significant, Intra-group analyses (Table 12) indicated the P group had more than tripled the incidence of Distortion of Circle-Diamond, compared with that of Separation, while the Secondary Group only doubled it. Organic group showed equal incidence of Distortion of Circle-Diamond and of Dots. The Adult group indicated only minimal Distortion of Circle-Diamond.

Conclusion

The first hypothesis that there would be a significant negative correlation between reading achievement and perceptual-motor dysfunction was accepted. Therefore reading achievement increases as perceptual-motor dysfunction decreases. The correlation was still significant, even with the adult group excluded.

The hypothesis that there would be no significant intra-group differences in types of errors was accepted for the Primary, Secondary and Adult groups; it was rejected for the Organic group, which had significant difficulty with the lateral arrow figure.

The hypothesis that there would be no significant inter-group differences in types of errors was rejected since there were significant differences on the vertical and horizontal arrow figures. Thus there were significant differences in types of errors within and between groups.

The most interesting finding is that the MPDT classifications of Primary, Secondary and Organic groups showed no significant differences in chronological or mental ages, school grade, WRMT scores and Instructional Reading Levels. Thus students in the three groups are fairly homogeneous, except for significant differences in degree of perceptual dysfunction. It is notable that the Organic group in particular had no significant differences in either mental age or reading instructional level.

The incidence of Brain-damage indicators increased respectively from Primary to Secondary and Organic groups. There were no significant differences within the four groups in separation of circle-diamond, distortion of circle-diamond and distortion of dots. Inter-group analysis showed that only the Organic group

had significant difficulty with distortion of dots. This finding conflicts somewhat with that of Fuller (1969) who found separations reflecting more serious impairment of perceptual-motor functioning than distortions. The Adult group had minimal or no problems here.

Interpretation

As Fuller and Friedrich (1975) have previously concluded, disabled readers must be studied in subgroups, and no longer grouped into a heterogeneous category. What is presently not known is what effect distortions, separations and rotations in reproductions have directly on the reading process. This report investigated the existing relationships of visual perceptual-motor functions as but one of the myriad complexities in the reading process. It does not infer a direct remedial prescription since many types of auditory perceptive and associative learning problems exist outside the scope of this study.

Limitations of the Tests

The following limitations of the MPDT should be noted: 1.) reproduction of forms is affected by the child's skill and ability with a pencil and by his ability to draw the lines and figures he actually sees, 2.) test results are influenced by lack of interest, fatigue and non-commitment, 3.) cut-off scores change abruptly from one classification to another whereas a "band" might be a more cautious measurement, and 4.) the label or designation "brain damage" is questionable; severe perceptual-motor dysfunction might be more acceptable.

Limitations of the WRMT include: 1.) Word Meaning subtest is really a test of analogies and two or three sample trials are hardly adequate to teach this skill, 2.) Passage Comprehension subtest is composed of only three sentences at the most difficult level, which is subject to criticism since the brevity hardly allows time for a "mind set" to operate.

Correlations indicate relationships; they do not show causes.

Unanswered Questions

Does information on perceptual-motor functioning of geometric patterns have any transfer or relation to perception of letters and words in the reading process? Rumelhart (1976) suggests that the perception of letters often depends on the surrounding letters, and perception of words depends on the syntactic environment in which they are encountered.

What are the practical implications of these relationships? Cohen (1972) recognizes the significance of perceptual dysfunction in reading retardation, but notes that independent variables theoretically related to reading achievement but operationally far removed, may have little observable influence.

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